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EP 0005137 A

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(54) Sliding door operating mechanism

(57) The sliding door operating mechanism comprises a belt (3) extending substantially horizontally above and beyond the door opening zone and around a pair of rollers (2) at least one of which is drivable. Mounting means (11) for said door are connected to the belt (3) for translational movement therewith. The belt may be endless with two parallel opposite runs, and in the case where two doors are provided to close together, the mounting means (11) for each door are connected to the endless belt on each of said opposite runs. A safety switch is optionally provided. It comprises means fixed for movement with the door, and an arm attached to the belt (3). The means and the arm are so mounted one to the other that relative movement is possible between them should the door encounter an obstruction and the drive means continue. A switch contacted by the arm may operate either to reverse or to stop the belt drive. At each end of travel of a door, a first switch slows the door, and a record switch stop the door. Electrical power may be fed to the door via a ribbon-type multi-strand cable running in a cable tray above the door.

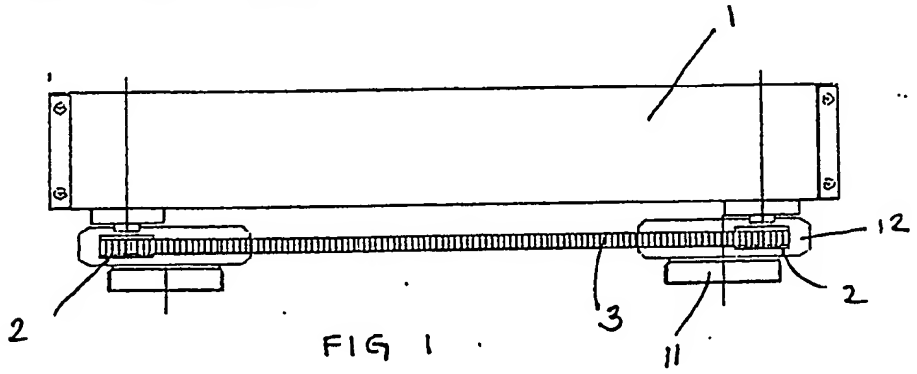

FIG 1

GB 2 213 524 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1982.

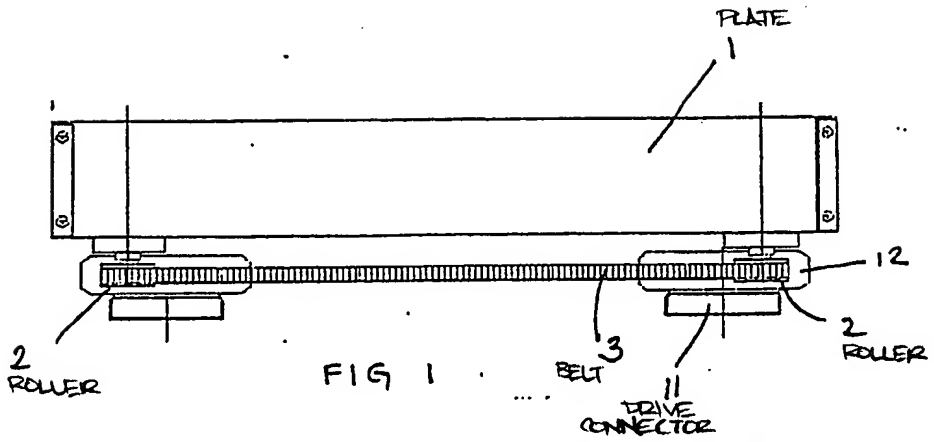
PLATE
1
12
2
ROLLER
2
ROLLER
3
BELT
11
DRIVE
CONNECTOR

FIG 1

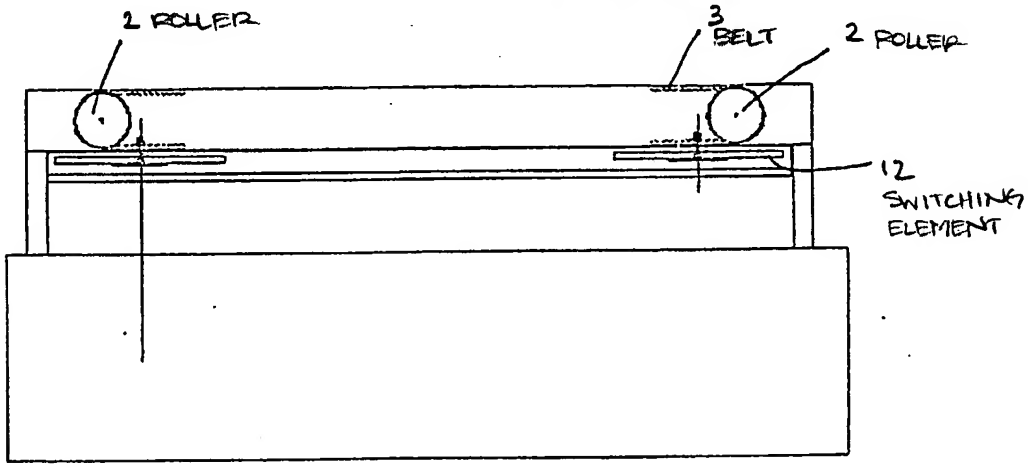
2 ROLLER
3
BELT
2 ROLLER
12
SWITCHING
ELEMENT

FIG 2

2213524

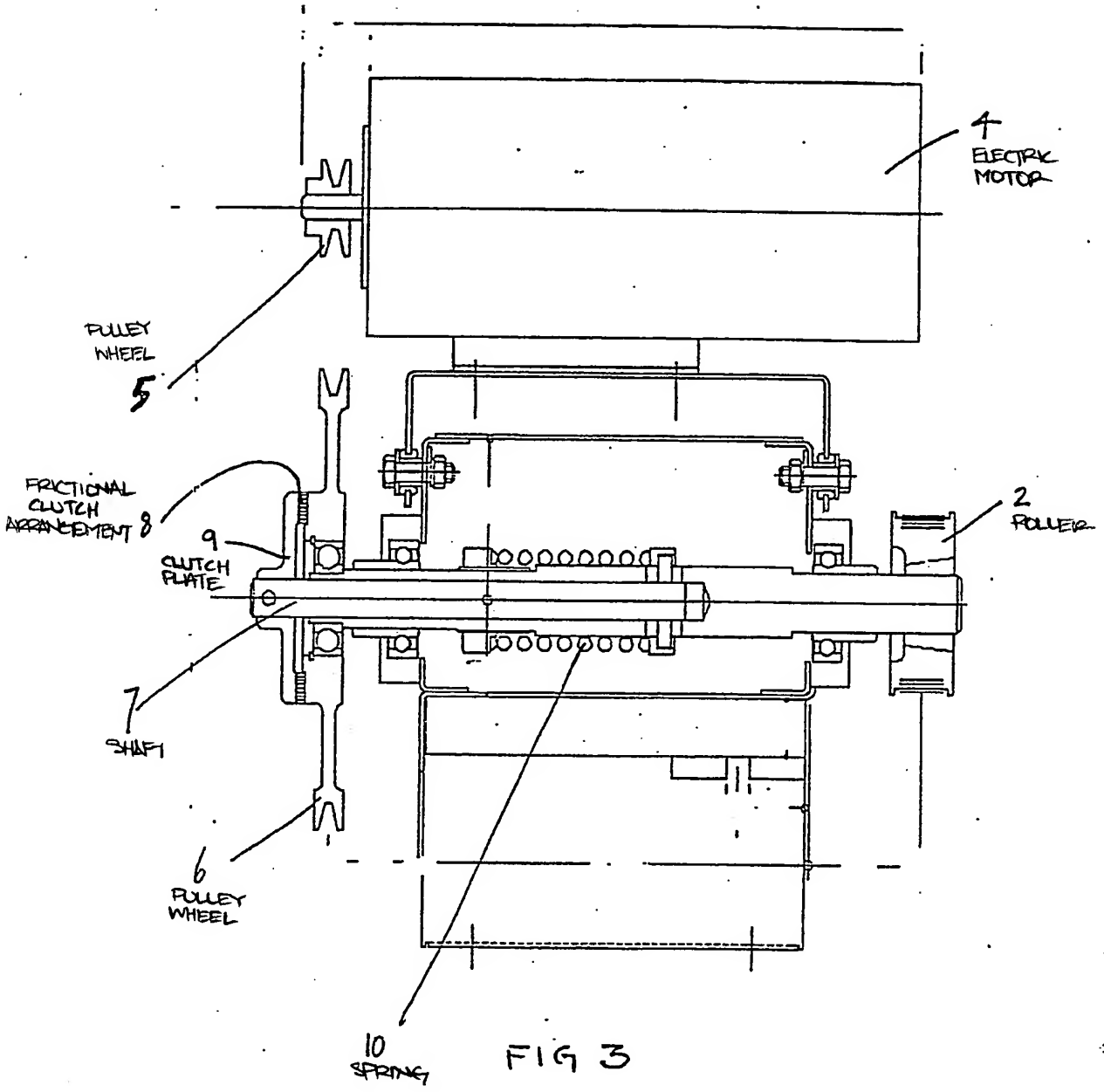

FIG 3

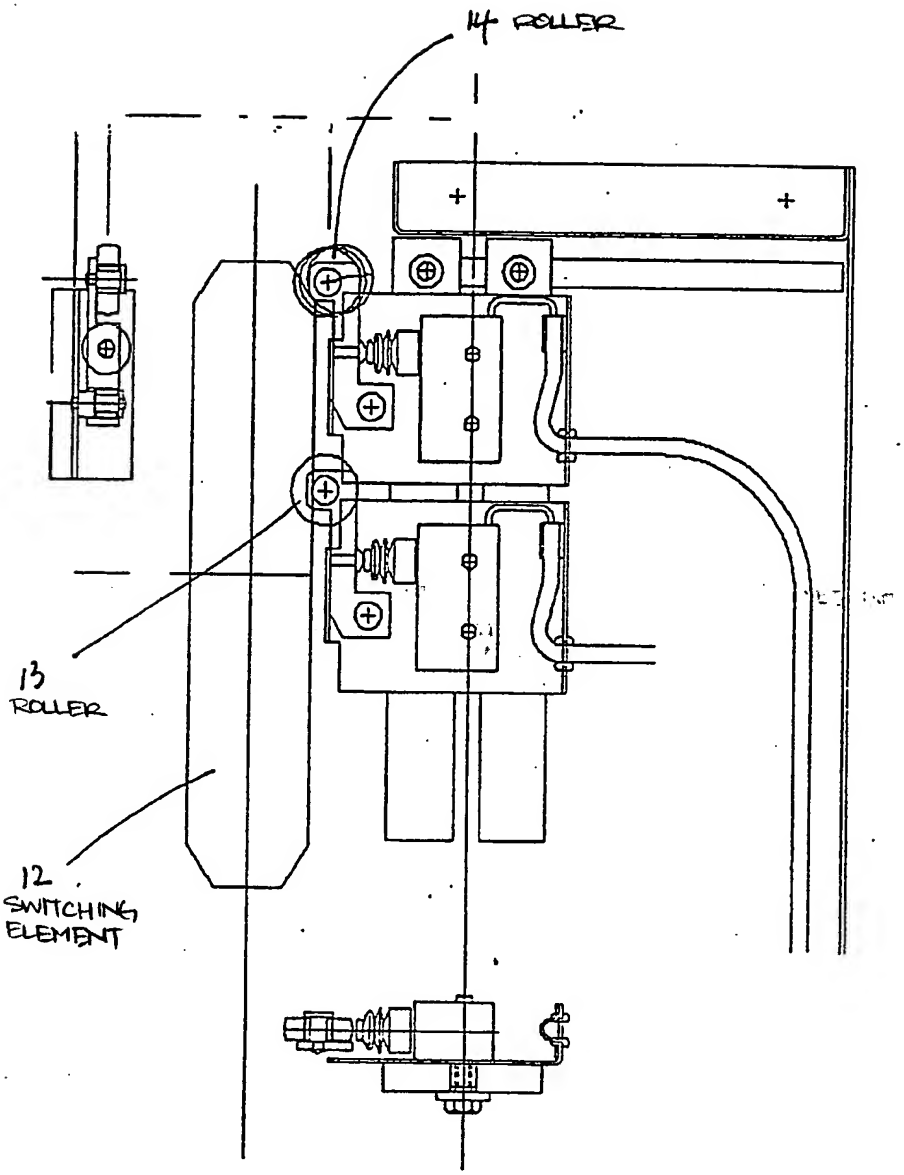

FIG 4

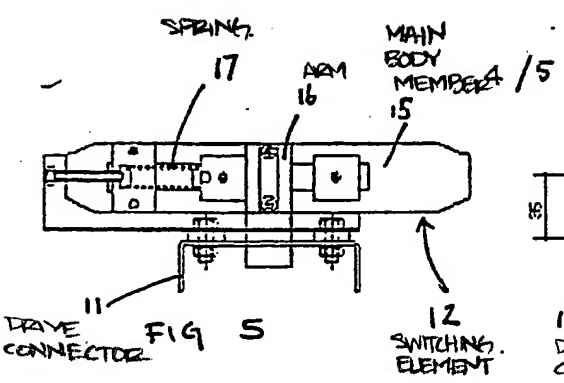

FIG 5

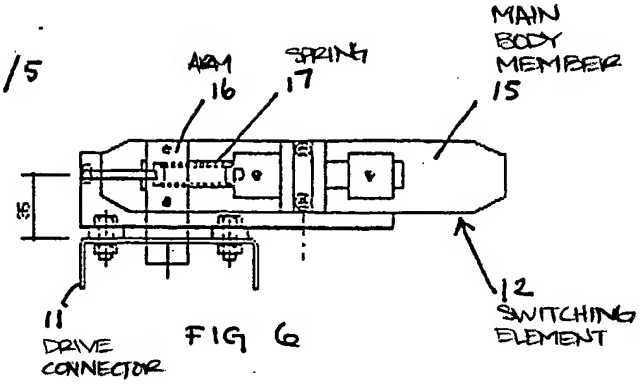

FIG 6

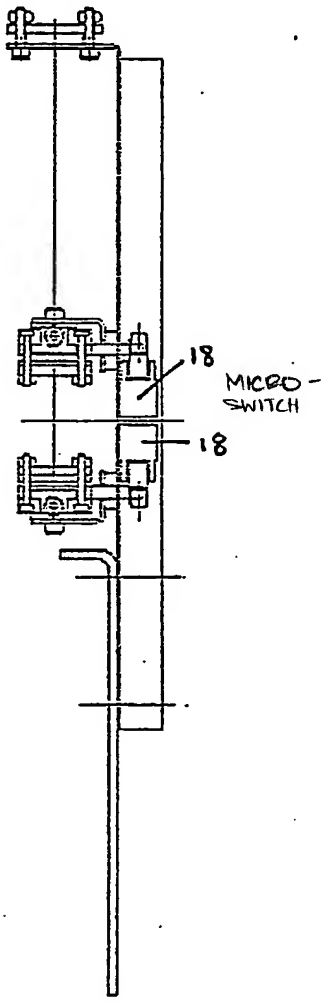

FIG 7

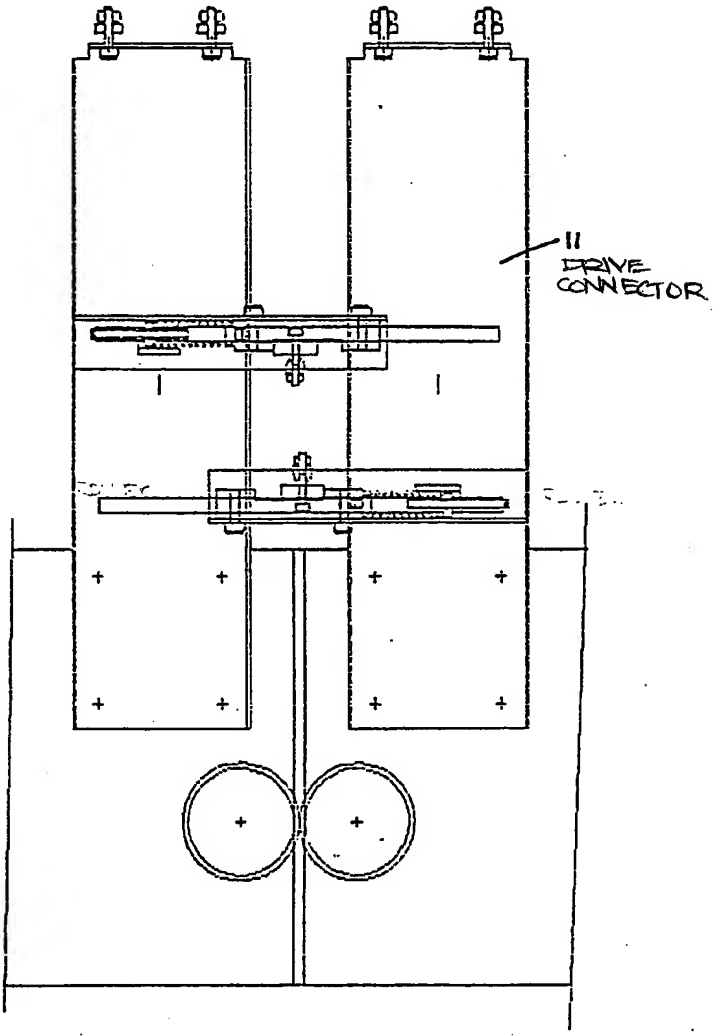

FIG 8

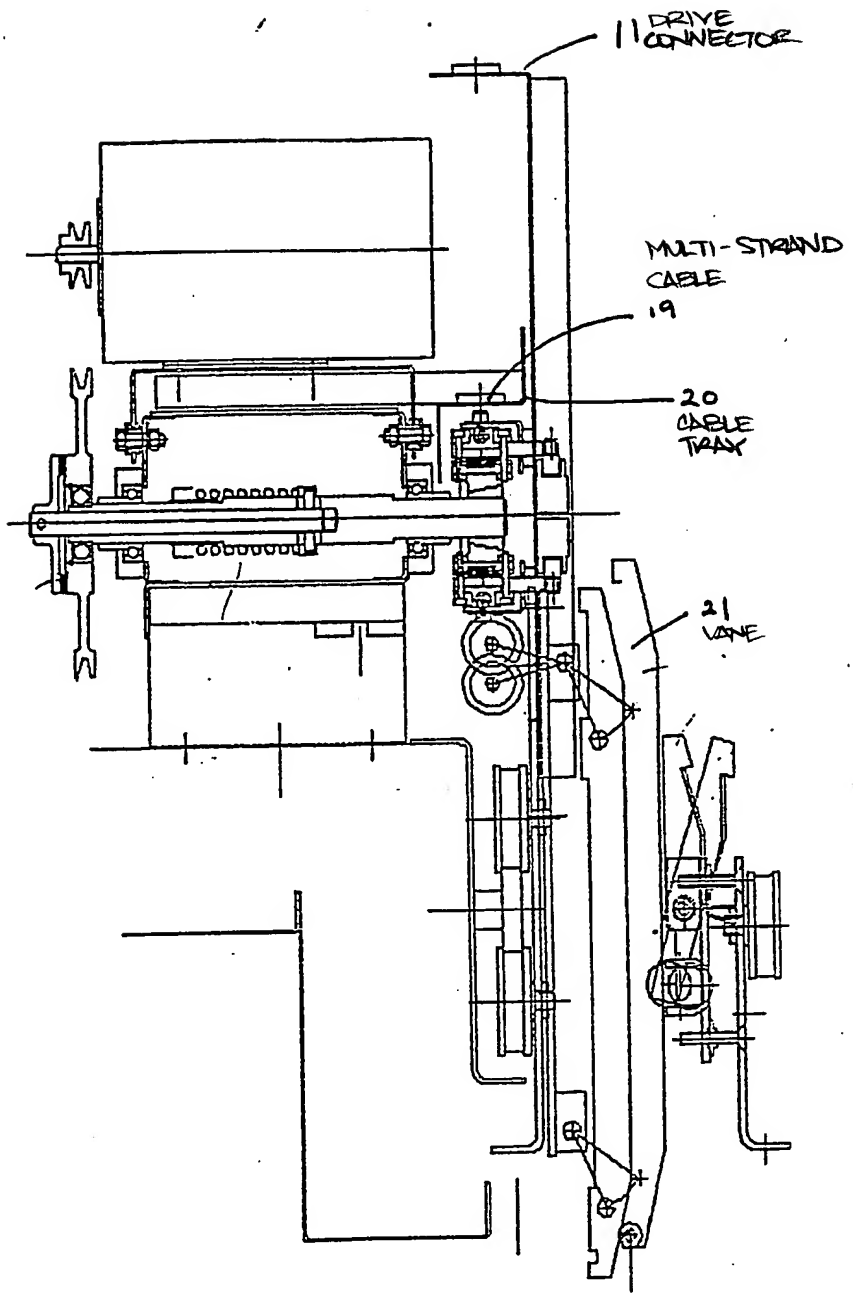
11 DRIVE CONNECTOR
MULTI-STRAND CABLE
19
20 CABLE TRAY
21 VANE

FIG 9.

SLIDING DOOR OPERATING MECHANISM

The present invention relates to a operating mechanism for sliding doors. More particularly, but not exclusively, the invention relates to a mechanism for operating lift or elevator doors.

The invention will be described with reference to its use in connection with lift doors although other uses can be foreseen.

Automatically operating lift car doors are well known and operate on a sliding door principle. The door opening may be closed either by a single door sliding to one side or a pair of double doors, each sliding to an opposite side of the opening. In both cases the door or doors may in fact comprise two or even more sub-doors which, on opening lie parallel to one another with one behind the other. On closing the doors, one of the sub-doors moves further than the other or others to form a continuous door, although still with one set back from the other.

The operating system for such doors, whatever their type, is generally an electric motor driving,possibly through a reduction pulley, a wheel with a crank arm attached to the door, usually at the top thereof.

Certain disadvantages are inherent in this system of door drive. For example, the arm length must be adjusted to the door opening width, and when double doors are used, the crank system becomes even more complex with

double crank arms. The flailing movement of the crank arms and wheels on top of the lift car requires that nothing projects into the path of the crank arm such that it may either block the passage thereof, or be damaged by the crank arm.

This closure system also requires a knuckle joint, and it is often difficult in such systems to ensure that movement of the door can be accomplished safely in both directions.

Finally, it is an unfortunate fact that lifts are often vandalised, and many facets of their operating mechanism are indeed particularly prone to being vandalised.

When the lift doors are open, there is generally a space above the doorway through which some parts of the mechanism can be reached, and damaged by those with malicious intent. One feature generally incorporated in lifts is a safety strip along the closing edge of the door or doors, the purpose of which is to prevent the doors closing on a person standing between them. When the safety strip contacts an obstacle, a switch is triggered to cause the doors to reopen. However, the safety strips are vulnerable to attack and can be removed, rendering the lift dangerous, or the working parts behind the safety strip may be tampered with.

Electrical power may be supplied to the lift doors by means of cables passing from the roof of the lift between the lift car doors and the landing doors. When the doors are open, these wires may be attacked.

It is one object of the present invention to provide a sliding door operating mechanism, especially for lifts, which overcomes the above disadvantages.

According to a first aspect of the present invention, there is provided a sliding door operating mechanism comprising a belt extending substantially

horizontally above the door opening zone, a pair of rollers, at least one of which is drivable, disposed one beyond each end of said zone and adapted to support and drive said belt, mounting means for said door connected to said belt for translational movement therewith, said door being mounted to said mounting means.

Said belt may be an endless belt passing around said pair of rollers, optionally with two substantially parallel opposite runs, and in the case where two doors are provided to close together, said mounting means for each door are connected to the endless belt at locations disposed one on each of said opposite runs. Thus, rotation of the driven roller in one direction may cause the two doors to move either towards one another or away from one another.

Preferably said mounting means further comprises connector means for moving a respective second door parallel to said door, for example a lift car door and a cooperating landing door.

Said drivable roller may be driven through clutch means by a motor.

Limit switch means may be provided at or near end positions of travel of said door, said switch being operable by the mounting means.

Preferably each end position of travel of each door is provided with two switches, a first one to signal an end of travel and cause said belt to stop, and a second one spaced from said first one to cause to belt to slow down prior to stopping.

It may be desirable for said door opening zone to be closable by more than one door, said more than one door opening simultaneously in a common direction. In such cases, there may be provided two or more belts, each door being mounted to a respective belt, the rollers for each said belt being of a different diameter, the ratio of

diameters being dependent on the ratio of distances to be travelled by the doors during the opening or closing procedure.

According to a second aspect of the present invention, there is provided a safety switch means for sliding doors, comprising first means fixed for movement with the or each door, second means attached to door linear drive means for movement therewith, said first and second means being so mounted one to the other that relative movement is possible between them should the door encounter an obstruction and the drive means continue, and switch means fixed for movement with the door operable on said relative movement by abutment means connected to or extending from said second means, said switch means operating either to reverse or to stop said door linear drive means.

Preferably said door linear drive means is a driven belt as described in the first aspect above.

Advantageously said second means is connected directly to said linear drive means.

The first and second means may be mounted together for relative movement between them against a spring bias.

The force exerted by the spring bias against relative movement may be predetermined, to set a level at which the switch means is actuated.

According to a third aspect of the present invention there is provided an apparatus for feeding electric power to a sliding door, comprising a ribbon type multi-strand cable connected at one end to the door and at the other end to the lift car, or lintel of the space closed by the door, at a location above the door opening zone adjacent to an end position of the door in its closed disposition, and running in a cable tray above the door opening zone.

An embodiment of the present invention will now

be more particularly described by way of example and with reference to the accompanying drawings, in which:

FIGURE 1 is a schematic plan view of a system embodying the invention;

FIGURE 2 is a front elevation of the system shown in Figure 1;

FIGURE 3 is a cross-sectional view showing a part of the system in more detail;

FIGURE 4 is a plan view of another part of the system;

FIGURE 5 is a plan view of a safety switch for use with a side opening door;

FIGURE 6 is a plan view of a safety swtich for use with a centre opening door;

FIGURE 7 is a cross-sectional view through a safety switch assembly as used in a centre opening pair of doors;

FIGURE 8 is an elevation of the safety switch assembly shown in Figure 7; and

FIGURE 9 is a cross-sectional view similar to that shown in Figure 3 but showing also a connecting vane for connecting car doors and landing doors.

Referring now to the drawings, the operating mechanism comprises a plate 1 extending across and above a door opening. Attached at each end of the plate 1 are rollers 2, around which passes a continuous belt 3. The term belt includes belts, such as timing belts, or chains, or any other convenient motion transmitting means.

Referring now to Figure 3, at least one of the rollers 2 is driven by means of an electric motor 4 acting through pulley wheels 5 and 6, connected together by a pulley belt. One 5 is connected to the drive shaft of motor 4 and the other 6 is journalled about an axis 7 connecting with roller 2. Pulley wheel 6 is drivingly connected to said shaft 7 by means of a frictional clutch

arrangement 8 between the pulley wheel 6 and a clutch plate 9. The clutch pressure can be predetermined by presetting a spring 10. It is intended that the clutch 8 will slip should the door, mounted on belt 3, meet an obstacle, thereby providing an inherent safety feature, but one which cannot be tampered with since it is located at the rear of the plate 1 and well above the top of the door. This safety feature applies both during closing of the door and opening of the door, i.e. it is bi-directional.

The door (not shown) is mounted to slide along a track, its movement being controlled by a drive connector 11 attached to the belt 3 by means of a switching element 12. In the case of a single door, it is preferably connected to the lower run of the continuous belt 3. In the case of double doors moving together for closing, one may be attached to the lower run of the belt 3, and the other to the upper run of the belt 3, one at or near each end when open for moving together when the belt is operated by the roller 2 moving in a single direction.

In the case where two doors slide in the same direction from a closed position where they lie one beside the other to an open position where they lie behind the other, i.e. one door moves twice as far as the other, it is possible to provide two belts 3, one being adapted to move twice as far for a similar duration of motor operation. This may best be accomplished by connecting this one belt around rollers of larger diameter than are the rollers around which the other belt passes. Referring to Figure 4, the switching element 12 is adapted to contact rollers 13 and 14 at each end of its travel when connected to the door. Roller 13 operates a micro-switch adapted to slow the motor and thereby slow down the movement of the door, while roller 14 is connected to a micro-switch for stopping the motor and thereby the door.

The switching element 12 is shown in more detail

in Figures 5 and 6. It comprises a main body portion 15 to which is attached the drive connector 11 and therefore the door. The belt 3 is clamped to an arm 16 which extends through a slot in the drive connector 11. Arm 16 is connected to the main body member 15 for relative sliding movement therebetween against a spring 17.

In normal operation of the door, arm 16 and body 15 move together to open and close the door. If the door meets an obstruction, the door and the main body member 15 of switching element 12 will stop, while the belt 3 and arm 16 continue to move. There is thus relative movement between body 15 and arm 16 until the portion of arm 16 within the drive connector 11 contacts a micro-switch 18 within the drive connector to cause reversal of the motor and therefore opening of the door.

Electrical power is fed to the door through a ribbon-type multi-strand cable 19 running in a cable tray 20. It is connected to the upper part of the drive connector 11, and its other end is connected to a lift car roof at a location above the door opening zone adjacent to an end position of the door in closed disposition. Thus, when the door is open and the cable is most vulnerable to vandalism, it lies substantially flat within the cable tray 20. As the door closes, the cable 19 loops up. It is, however relatively safe from vandals since the doors are closed by this time. In any event, it is protected by cable tray 20 and is well above the top of the door. One further advantage of utilising this method of cabling is that it allows motorising of the vane 21 which connects between the car doors and landing doors.

As can be seen, the operating mechanism is extremely simple, relying only on a continuous belt revolving around a pair of rollers. However, this can be located well out of the reach of vandals, and in fact can be so arranged that a protective plate separates the belt

from any accessible opening while the drive connectors pass in front of or around any such protective plate. Since the driven roller is operated through a clutch mechanism, it is inherently bi-directionally safe.

Safety is further improved by means of a sensitive edge switch 12 which again is out of the reach of vandals. Furthermore, the electrical cable can now be connected to the door by means which are again out of the reach of vandals.

CLAIMS:

1. A sliding door operating mechanism comprising a belt extending substantially horizontally above the door opening zone, a pair of rollers, at least one of which is drivable, disposed one beyond each end of said zone and adapted to support and drive said belt, mounting means for said door connected to said belt for translational movement therewith, said door being mounted to said mounting means.

2. A mechanism as claimed in claim 1, wherein said belt is an endless belt passing around said pair of rollers, with two substantially parallel opposite runs.

3. A mechanism as claimed in claim 2, wherein two doors are provided to close together, and said mounting means for each door are connected to the endless belt at locations disposed one on each of said opposite runs, whereby rotation of the driven roller in one direction causes the two doors to move either towards one another or away from one another.

4. A mechanism as claimed in any one of the preceding claims, wherein said mounting means further comprises connector means for moving a respective second door parallel to said door, for example a lift car door and a cooperating landing door.

5. A mechanism as claimed in any one of the preceding claims, wherein said drivable roller is driven through clutch means by a motor.

6. A mechanism as claimed in any one of the preceding claims, wherein limit switch means are provided at or near end positions of travel of said door, said switch means being operable by the mounting means.

7. A mechanism as claimed in claim 6, wherein each end position of travel of each door is provided with two switches, a first one to signal an end of travel and cause said belt to stop, and a second one spaced from said first one to cause the belt to slow down prior to stopping.

8. A mechanism as claimed in any one of the preceding claims, wherein said door opening zone is closable by more than one door movable simultaneously in a common direction, each door being mounted to a respective one of two or more belts, the rollers for each said belt being of a different diameter, the ratio of diameters being dependent on the ratio of distances to be travelled by the doors during the opening or closing procedure.

9. A sliding door operating mechanism comprising a safety switch means for preventing closure of the door should it encounter an obstacle, said safety switch means comprising first means fixed for movement with the or each door, second means attached to door linear drive means for movement therewith, said first and second means being so mounted one to the other that relative movement is possible between them should the door encounter an obstruction and the drive means continue, and switch means fixed for movement with the door and operable upon said relative movement by abutment means connected to or extending from said second means, said switch means operating either to reverse or to stop said door linear drive means.

10. A mechanism as claimed in claim 9, wherein said door linear drive means comprises a driven belt extending substantially horizontally above the door opening zone.

11. A mechanism as claimed in either of claims 9 or 10, wherein said second means is connected directly to said linear drive means.

12. A mechanism as claimed in any one of claims 9 to 11, wherein the first and second means are mounted together for relative movement between them against a spring bias.

13. A mechanism as claimed in claimed in claim 12, wherein the force exerted by the spring bias against relative movement is predetermined to set a level of obstruction at which the switch means is actuated.

14. A sliding door operating mechanism comprising an electric power feed to said sliding door, said feed comprising a ribbon type multi-strand cable connected at one end to the door and at the other end to a lintel of the space closed by the door, at a location above the door opening zone adjacent to an end position of the door in its closed disposition, said cable running in a cable tray above the door opening zone.

15. A sliding door operating mechanism substantially as described herein with reference to the Figures of the accompanying drawings.